REMARKS

In response to the Examiner's inquiry, the specification at page 13 has been amended to correct inadvertent errors. With this amendment, the specification consistently describes that the area of the positive electrode is larger than that of the negative electrode in the first embodiment, and that the area of the negative electrode is larger than that of the positive electrode in the second embodiment (see page 20, lines 4-16). The first embodiment is used for the measurement of oxygen concentration, whereas the second embodiment is used as a humidity sensor.

Responsive to the rejection of original claims 12 and 13 under 35 U.S.C. § 112, second paragraph, Applicants advise that the "ceramic body capable of electrically controlling the rate of oxygen ion conduction" corresponds to the oxygen ion pump cell 66 (page 22, line 1 and Fig. 11A). A voltage is applied across electrode 66a, 66b to thereby control the oxygen ion conduction of the ceramic body and reduce the oxygen content within a first measurement chamber 62 formed between the ceramic body (i.e., the oxygen ion pump cell 66) and the oxygen concentration measuring cell 67. The oxygen concentration measuring cell 67 measures the oxygen concentration inside the first chamber 62. Thus, a certain gas of interest such as NOX entering through a first diffusion hole 61 into the first chamber 62 becomes relatively rich, compared to the oxygen in the first measurement chamber 62. This enriched gas then enters into a second chamber 64 through the second diffusion hole 63 where it is decomposed. Oxygen generated by the decomposition of NOX is detected as a current measured between electrodes 68a and 68b formed in a coplanar position on the same inner surface of a second pump cell substrate 68. As shown by Fig. 11D, electrode 68a (negative electrode) is larger than electrode 68b (positive electrode).

Review and reconsideration on merits are requested.

Claims 1-8 and 10-15 were rejected under 35 U.S.C. § 102(a) as being anticipated by U.S. Patent 5,672,811 to Kato et al.

Claims 1-7, 10 and 11 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 5,403,452 Heilscher et al.

Claims 6-8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Heilscher et al in view of Kato et al.

Claims 1-8, 10, 11, 14 and 15 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 4,502,939 to Holfelder et al.

Claim 7 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Holfelder et al in view of Kato et al.

Claims 1, 8, 10 and 11 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 4,724,061 to Nyberg.

Claim 9 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Kato et al, Heilscher et al, Holfelder et al or Nyberg in view of JP 5-87773 or U.S. Patent 4,657,659 to Mase et al.

The Examiner cited Kato et al (Fig. 2) as showing a sensor including electrodes 28 and 24 provided on the same side of support 4c where electrode 28 has an area at least two fold that of electrode 24.

Heilscher et al (Fig. 8) was cited as disclosing a sensor including electrode 2 having an area at least two fold that of electrode 1 provided on the same side of support 4 and including diffusion limiting means 14.

Holfelder et al (Fig. 5) was cited as disclosing a sensor including electrode 539 having an area at least two fold that of electrode 548 disposed on the same side of a zirconia solid electrolyte.

Nyberg was cited as disclosing a sensor including electrodes 20 and 22 disposed on the same side of a zirconia support 18, where electrode 20 has an area one and a half times that of electrode 22.

JP '773 and Mase et al were cited as showing sensors including an embedded electrode.

Applicants traverse, and respectfully request the Examiner to reconsider his position in view of the amendments to the claims and the following remarks.

The present invention is based on Applicants' discovery that the electric resistance between electrodes disposed coplanar on the same side of a solid electrolyte substrate constituting a detection cell can be minimized by appropriately specifying the electrode-area relationship between the positive and negative electrodes. As a result, the S/N ratio is improved. This is particularly important because the detection current in such a sensor having a coplanar electrode arrangement can be rather small.

This phenomenon is shown in Fig. 6, where the element resistance is minimized when the area ratio of the negative and positive electrodes ranges from 2:1 to 5:1 or from 1:2 to 1:5. When the negative and positive electrodes have the same area (i.e., a ratio of 1:1), the element

resistance is remarkably increased. Likewise, the element resistance is likewise increased at an area ratio exceeding 5:1 or 1:5.

Claim 16 recites that the area ratio of the negative and positive electrodes is such that the element resistance measured between the negative and positive electrodes is 94% or less than the element resistance of the same sensor in which the negative electrode and the positive electrode have the same area. Claims 17-20 define certain ranges of the area ratio, applied electric potential and element resistance relative to a sensor in which the negative electrode and the positive electrode have the same area.

None of the references cited by the Examiner discloses this aspect of the invention.

Moreover, although drawings can be used as prior art, proportions in a drawing are not evidence of actual proportions when drawings are not to scale (MPEP § 2125). Thus, it is respectfully submitted that the Examiner's reliance on the figures of Kato et al, Heilscher et al and Holfelder et al with respect to area ratios is inappropriate. The references do not disclose that the drawings are to scale, and there is nothing in the disclosure of these references, taken in combination with the drawings, that would convey the area ratios of the coplanar electrodes.

Claims 25, 31 and 32 are directed to a sensor where a pump current of less than 100 microamperes flows between the first and second electrodes when used to determine the concentration of a gas. This particular embodiment, described at pages 34-35 of the specification, takes advantage of the low internal resistance of the sensor for measuring small gas concentrations which give rise to very low pump currents. The low internal resistance achieved

by setting the area ratio in the range of 2:1 to 5:1 or 1:2 to 1:5. Nothing in the applied prior art discloses this aspect of the invention.

Withdrawal of all rejections and allowance of claims 16-32 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

Respectfully submitted,

Abraham J. Rosner
Registration No. 33,276

SUGHRUE, MION, ZINN,
MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, D.C. 20037-3213
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

Date: March 9, 2001

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Page 13, lines 13-22, first full paragraph:

As shown in FIGS. 1, 2A, and 2B, in the first limiting-current-type sensor 10 of the first embodiment, the area ratio between the [negative electrode 34a and the] positive electrode 32a and the negative electrode 34a is set to 2:1. As a result, element resistance is reduced, as will be described later, to 74% that of the conventional flat limiting-current-type sensor which has been described above with reference to FIGS. 12B and 12C and in which the negative electrode 132 and the positive electrode 134 assume the same area. Thus, measurement accuracy is improved accordingly.

Page 13, line 23 - page 14, line 4:

In the flat limiting-current-type sensor of the first embodiment serving as an oxygen sensor, a voltage of 0.7 V is applied between the negative electrode 34a and the positive electrode 32a. Thus, the area ratio between the [negative electrode 34a and the] positive electrode 32a and the negative electrode 34a is set to 2:1, thereby reducing element resistance. Element resistance was experimentally measured with respect to different area ratios between the negative electrode 34a and the positive electrode 32a. The test results will be described with reference to FIGS. 5A and 6.

IN THE CLAIMS:

Claims 1-15 are canceled.

Claims 16-32 are added as new claims.